Malays. Appl. Biol. (2011) 40(1): 13-17

COMPOSITION OF GASTROPODS IN MANGROVES OF TANJUNG DAWAI AND PULAU SAYAK, KEDAH

FAEZAH, P.* and FARAH, H.S.

Faculty of Applied Sciences, Universiti Teknologi MARA,
40450 Shah Alam, Selangor, Malaysia
**E-mail: faezahpardi@salam.uitm.edu.my*

ABSTRACT

A total of 426 individuals from six families, six genera and ten species were collected from Tanjung Dawai while a total of 351 individuals from five families, five genera and six species were collected from Pulau Sayak. Six families that were found from Tanjung Dawai were Littorinidae, Neritidae, Potamididae, Ellobiidae, Muricidae and Assimineidae while five families that were found from Pulau Sayak were Littorinidae, Ellobiidae, Muricidae, Assimineidae and Naticidae. The abundant species at both mangrove areas were *Cerithidea cingulata* and *Naticidae* sp. Shannon Diversity Index and Evenness Index for Tanjung Dawai were 1.95 and 0.85, respectively. Shannon Diversity Index and Evenness Index for Pulau Sayak were 1.27 and 0.71, respectively. Both of the mangroves habitats of Tanjung Dawai and Pulau Sayak, Kedah appeared to have low snail species diversity but still sustain some common gastropod families of tropical mangroves. It is essential to have an economically and ecologically sound management plan in order to make the mangroves ecologically viable as well as a source of economy.

Key words: snail, species richness, mangrove, Tanjung Dawai, Pulau Sayak.

INTRODUCTION

Tanjung Dawai and Pulau Sayak are located on the state of Kedah, Peninsular Malaysia. Kedah is one of the tsunami-hit states in Malaysia on the 26th December 2004 besides Penang, Perak and Selangor. A total of five villages situated on the shoreline between Tanjung Selat in the north and Kuala Sungai Muda in the south of Kedah were affected by the tsunami namely Kuala Sungai Muda, Kg, Kepala Jalan, Kg. Masjid, Kg. Paya and Kg. Pulau Sayak. Other areas that also affected were Kg. Huma, Tanjung Dawai and Pantai Merdeka (Siwar *et al*., 2006). Apart from damages caused to life and property, tsunami had done extensive damage to ecosystem. Initial reports indicate that natural ecological systems such as coral reefs, mangroves and wetlands have suffered significant damages (Ramachandran *et al*., 2005). The tsunami impacts in Kota Kuala Muda, Kedah also caused the destruction of mangrove which are composed of several species such as *Avicennia alba, Avicennia lanata, Rhizophora mucronata, Rhizophora apiculata* and *Bruguiera gymmnorrhiza* (Siwar *et al*., 2006).

Such a major damage in mangrove area will severely affect the coastal productivity and destabilize coastal areas, which will accelerate shoreline erosion and increasingly affect the forest area due to salt-water intrusion into the forests. Since natural regeneration of mangroves will take considerable time between 10 to 15 years, the tsunami impact on mangrove forest will be severe in this area (Ramachandran *et al*., 2005). The loss of mangroves will also affect the habitat for a wide variety of commercial species, including fish, prawns, crabs, oysters and other shellfish. There are few quantitative data of the diversity, density, and biomass of molluscs in mangroves (Printakoon *et al*., 2008) especially in area that was affected by Tsunami. The present study focused on the gastropod composition since much of the information for both of these mangroves Tanjung Dawai and Pulau Sayak has not been comprehensively inventoried after the tsunami event. Therefore, this study could help to fill in gap in our knowledge about the composition of gastropods particularly snail species in the tsunami-affected mangrove areas in Kedah especially when the affected areas had undergone an extensive replanting programme such as Pulau Sayak on 7th February 2005. Thus, there is a need to document the

* To whom correspondence should be addressed.

composition of gastropod especially on the replanting mangrove area to monitor any changes and pattern in the gastropod composition from time to time. This study will serve as a foundation for future studies and also to develop an inventory of gastropod species diversity to make the mangroves ecologically viable as well as a source of economy.

MATERIALS AND METHOD

Study area

Kota Kuala Muda (5º34'60"N, 100º22'60"E) district is situated south of Kedah and it can be characterized by its wide and low plains of sprawling paddy plantations. There are 16 mukims in the Kuala Muda District, Kedah in which Tanjung Dawai and Pulau Sayak belongs to Mukim Merbok and Mukim Bukit Meriam, respectively. According to the Kuala Muda District Office, for the whole district of Kuala Muda (92,300 ha), the largest land-use activity is agriculture followed by forest land, mangroves, aquaculture, housing and others activity such as industry and commercial. There are no human dwellings within the mangroves area of Tanjung Dawai and Pulau Sayak but there are number of villages on the fringes whose population rely on mangrove and its related resources mainly mangrove timber and fish. The sampling work commenced on April 2010. Surveys and sampling at Kota Kuala Muda were carried out at two selected study site namely Tanjung Dawai at 5º40'60"N, 100º22'0"E and Pulau Sayak at 5º40'0"N, 100º19'60"E. (Figure 1)

Sampling methods

Three transect lines made up with nylon rope were set up in each of the two study sites. Along each transect line, three quadrats each of 5m x 5m in size was established at 10 meter intervals. The distance between each transect line is 50 meter. Visible snail was collected in the quadrat by hand picking during day-time low tide while the arboreal forms were collected from the stems, trunks and other parts of the mangrove trees vertically. Snail occupied the mudfloor also were collected. All collected snails were placed separately in the labeled plastic bag. All collected samples were bathed in 4% formalin solution to fully-killed them. Then, samples were transferred into 70% ethyl alcohol for preservation. Collected snails were identified and sorted according to its species. The shell characters such as shape, spire length and shape, mouth opening, opercular shape, umbilicus shape and size, colour and ornamentation of the shell were used mainly for the identification (Torres *et al*., 2008). In this study, biodiversity indices used were H' (Shannon-Weaver's index) and E_H (evenness indices). Shannon-Wiener Diversity Index (H') was calculated according to the formula given below;

$$H' = - \sum_{I=1}^{S} (pi) (\ln pi)$$

where
s = the number of species
pi = the proportion of individuals or the abundance of the *i*th species expressed as a proportion of total abundance
ln = $\log \text{base}_n$

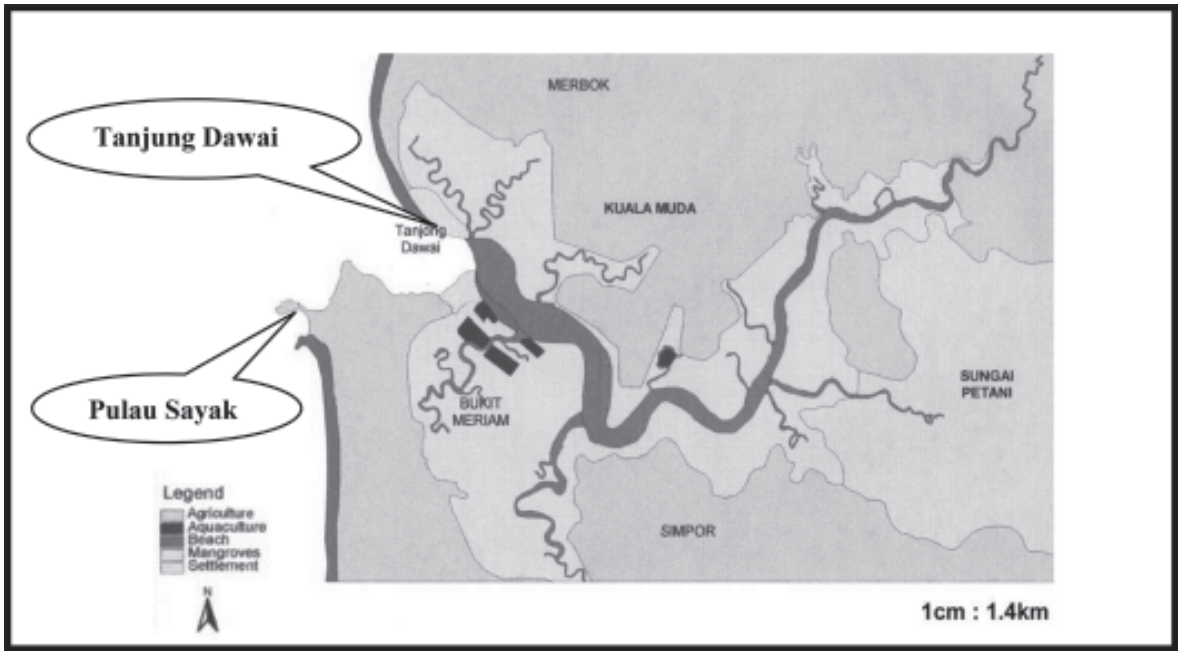

Fig. 1 The sampling area of gastropod snail at Tanjung Dawai and Pulau Sayak, Kedah.

Using these H' value, evenness value (E_H) was estimated according to the formula $E_H = H'/\ln S$, where S is the total number of species.

RESULTS AND DISCUSSION

A total of 777 individuals were collected from Tanjung Dawai and Pulau Sayak. Tanjung Dawai recorded a total of 426 individuals from six families, six genera and ten species (Table 1). Study site in Pulau Sayak recorded a total of 351 individuals from five families, five genera and six species (Table 2).

According to MacNae (1968), Littorinidae, Neritidae, Potamididae, Cerithidae and Ellobiidae are all the common gastropod families of tropical mangroves. The result was parallel with this study as the gastropods families found in Tanjung Dawai were also from families of Littorinidae, Neritidae, Potamididae, Cerithidae and Ellobiidae, with addition of Muricidae and Assimineidae. In Pulau Sayak, families of Littorinidae, Ellobiidae, Muricidae, Assimineidae and Naticidae were found within the sampling site.

Table 1. Snail species composition in mangrove area at Tanjung Dawai, Kedah.

No.	Family	No of Individuals
	Ellobiidae	
1	*Ellobium aurisjudae*	19
	Littorinidae	
2	*Littoraria melanostoma*	46
3	*Littoraria conica*	30
4	*Littoraria scabra*	14
	Muricidae	
5	*Chicoreus capucinus*	16
	Potamididae	
6	*Cherithidea cingulata*	148
7	*Cherithidea obtusa*	37
	Neritidae	
8	*Nerita lineate*	32
9	*Nerita planospira*	7
	Assimineidae	
10	*Sphaerassiminea miniata*	77
Total		**426**

Habitats were divided into four area occupied were trunk, stem, leaves and mudfloor. Only three species occupied the trunk, which were *Nerita lineata*, *N. planospira*, and *Cerithidea obtusa* with relative density of 7.50%, 1.64%, and 8.69%, respectively (Table 3). There were three species that occupied the stem which were *Littoraria melanostoma*, *L. scabra* and *L. conica* with relative density of 7.98%, 7.94%, and 3.30% respectively. *Littoraria melanostoma* also was found in leaves, with relative density of 2.82%. Subsequently, four species were distributed horizontally on the mudfloor. These include 18.08% of *Sphaerassiminea miniata*, 3.76% *of Chicoreus capucinus*, 34.74% of *Cerithidea cingulata,* and *Ellobium aurisjudae* with 4.46%.

In Pulau Sayak, only *Littoraria scabra* occupied the tree trunk with relative density of 6.27% (Table 4). *Littoraria melanostoma* and *Phythia plicata* were found on the stem with relative density of 4.56% and 1.42%, respectively. *P. plicata* also were found on the leaves of the three with relative abundance of 4.27%. There were three species occupied at the mudfloor. These species includes *Sphaerassiminea miniata*, *Chicoreus capucinus*, and *Naticidae* sp. with relative abundance of 26.21%, 3.42%, and 53.85%, respectively. Mangrove invertebrates often show marked zonation patterns, and colonise a

Table 2. Snail species composition in mangrove area at Pulau Sayak, Kedah.

No.	Family	No of Individuals
	Ellobidae	
1	*Pythia plicata*	20
	Littorinidae	
2	*Littoraria melanostoma*	16
3	*Littoraria scabra*	22
	Muricidae	
4	*Chicoreus capucinus*	12
	Naticidae	
5	*Naticidae* sp.	189
	Assimineidae	
6	*Sphaerassiminea miniata*	92
Total		**351**

Table 3. Distribution of snail species according to habitat in mangrove area at Tanjung Dawai, Kedah

No.	Species	Trunk	Stem	Leaves	Mudfloor
1.	*Nerita lineata*	7.50%	-	-	-
2.	*Nerita planospira*	1.64%	-	-	-
3.	*Cerithidea obtusa*	8.69%	-	-	-
4.	*Littoraria melanostoma*	-	7.98%	2.82%	-
5.	*Littoraria scabra*	-	7.04%	-	-
6.	*Littoraria conica*	-	3.30%	-	-
7.	*Sphaerassiminea miniata*	-	-	-	18.08%
8.	*Chicoreus capucinus*	-	-	-	3.76%
9.	*Cerithidea cingulata*	-	-	-	34.74%
10.	*Ellobium aurisjudae*	-	-	-	4.46%

Table 4. Distribution of snail species according to habitat in mangrove area at Pulau Sayak, Kedah

No.	Species	Trunk	Stem	Leaves	Mudfloor
1.	*Littoraria melanostoma*	-	4.56%	-	-
2.	*Phythia plicata*	-	1.42%	4.27%	-
3.	*Littoraria scabra*	6.27%	-	-	-
4.	*Sphaerassiminea miniata*	-	-	-	26.21%
5.	*Chicoreus capucinus*	-	-	-	3.42%
6.	*Naticidae* sp.	-	-	-	53.85%

variety of specific micro-environments. While some species dwell on the sediment surface or reside in burrows, others live on pneumatophores and lower tree trunks or prop-roots, burrow in decaying wood, or can even be found in the tree canopies (Ashton, 1999).

The distribution of gastropods within a mangrove forest is influenced by a variety of factors such as light, tidal exposure, salinity and substrate type (Nagerkelken *et al.*, 2007). Besides that, diet preferences and predation also may become factors on the species distribution. For example, *Littoraria* sp. commonly occupied above the mangrove tree because they feed on epibenthic crusts on stems and roots, as well as grazing on the leaves for food. On the other hand, family Potamididae, such as *Cerithidea cingulata* and *Cerithidea obtusa* had been observed rested on tree trunks during high tide, creeping on the mudflat below the tree for part of low tide, and returning on the trunks well before being reached by the water (Vanini *et al*., 2006). *C. cingulata* is most often found on areas of relatively firm and sandy substrate, but at some sites it may be almost totally overgrown by algae (Gary and Richard, 2006). It also lay out on mudflats in large numbers, typically fully exposed to the sun at low tide.

Diversity of snail species in Tanjung Dawai and Pulau Sayak calculated using the Shannon-Wiener diversity index (H') shows a value of 1.95 and 1.27, respectively (Table 5). The results of Shannon Weiner Diversity Index and Pielou's Evenness Index show the number of snail species was significantly higher in Tanjung Dawai than in Pulau Sayak, due to a variety of microhabitats available in the form of various roots of mangrove plants in which most of the snail species thrive well. In a way, high density of snail species might reflect the well-being of mangrove habitats of Tanjung Dawai. However, the value is considerable low as most of the mangrove areas were converted into aquaculture pond for prawns and fish culture in the late 1970's (Jin, 2006). The remaining untouched mangrove areas still can sustain some common gastropod families. In comparison to mangrove of Pulau Sayak, which consist of the mudflat and replanted seedlings still can support its own snail species but lower than Tanjung Dawai due to the mangroves area that still undergo growth process after replanting programme. The replant area of Pulau Sayak is 3.0 ha with 18,000 mangrove seedlings planted. The tree planting programme with mangrove was formed under Ministry of Natural Resources and Environment (NRE) on 7th February 2005 as in response to the suggestion of Malaysian Government to increase the conservation and protection efforts of the coastal areas after the Tsunami incident (FRIM, 2007).

Table 5. Summary on species diversity indices at the mangroves of Tanjung Dawai and Pulau Sayak, Kedah.

Study site	Shannon Weiner Diversity Index	H' max	Evenness Index
Tanjung Dawai	1.95	2.3	0.85
Pulau Sayak	1.27	1.8	0.71

According to study conducted by de Boer (2006), substrates under a larger total stress or disturbed load had lower species diversity and lower evenness as in Pulau Sayak. The reduced abundance of gastropods in the disturbed mangroves also may be related to reduce habitat complexity. The frontline mangrove tree in Pulau Sayak was extensively vanished and changed into open coastline, leaving only backline trees standing. Such destruction can affect the distribution of gastropods by direct removal of the tree habitat, altered sediment rates and tidal inundation.

CONCLUSION

As a general conclusion, the most abundant species at Tanjung Dawai and Pulau Sayak are genus *Cherithidea* and *Naticidae*, respectively. Both of the mangroves area appeared to have low snail species diversity but it is apparent that the evenness in this study is high and most species are represented by more or less similar number of individuals. In order to maintain the complexity of this mangrove forest and its species diversity, an economically and ecologically sound management plan is desirable with minimum disturbance to the forest ecosystem. There is a need to have an inventory, information system, research and development network and an

assessment and monitoring of gastropod species diversity to make the mangroves ecologically viable as well as a source of economy.

REFERENCES

Ashton, E.C. 1999. *Biodiversity and community ecology of mangrove plants, molluscs and crustaceans in two mangrove forests in Peninsular Malaysia in relation to management practices*. Ph.D. Thesis. University of York, UK.

de Boer, W.F. and Prins, H.H.T. 2001. The community structure of a tropical intertidal mudflat under human exploitation. *ICES Journal of Marine Science*, **59**: 1237-1247.

FRIM. 2007. *Annual Report*. Forest Research Institute Malaysia, Kepong, Selangor. 75pp.

Gary, R.F. and Richard, J.H. 2006. Intertidal Molluscs in UAE Lagoons. *Tribulus.* **16(2)**: 17-23.

Jin, E.O. 2006. Pre- and post-tsunami coastal planning and land-use policies and issues in Malaysia. www.fao.org.

MacNae, W. 1968. A general account of the fauna and flora of mangrove swamps and forests in the Indo-West Pacific region. *Adv. Mar. Biol.* **6**: 73-230.

Nagelkerken, I., Blaber, S.J.M., Bouillon, S., Green, P., Haywood, M., Kirton, L.G., Meynecke, J.O., Pawlik, J., Penrose, H.M., Sasekumar, A. and Somerfield, P.J. 2007. The habitat function for mangroves for terrestrial and marine fauna: a review. *Aquatic Botany,* **89**: 155-185.

Printakoon, C., Wells, F.E. and Chitramvong, Y. 2008. Distribution of molluscs in mangroves at six sites in the upper gulf of Thailand. *The Raffles Buletin of Zoology,* **18**: 247-257.

Ramachandran, S., Anitha, S., Balamurugan, V., Dharanirajan, K., Ezhil Vendhan, K., Divien, M.I.P., Senthil, V.A., Hussain, I.H. and Udayaraj, A. 2005. Ecological impact of tsunami on Nicobar Islands (Camorta, Katchal, Nancowry and Trinkat). *Curr. Sci., 89,* 1.

Siwar, C., Ibrahim, M.Z., Harizan, S.H.M. and Kamaruddin, R. 2006. *Impact on tsunami on fishing, aquaculture and coastal communities in Malaysia*. Proceeding of Persidangan Antarabangsa Pembangunan Aceh. Universiti Kebangsaan Malaysia. 41-51.

Torres, P., Alfiado, A., Glassom, D., Jiddawi, N., Macia, A., Reid, D.G. and Paula, J. 2008. Species composition, comparative size and abundance of the genus *Littoraria* (Gastropoda: Littorinidae) from different mangrove strata along the East African coast. *Hydrobiologia,* **614**: 339-351.

Vanini, M., Rorandelli, R., Lahteenoja, O., Mrabu, E. and Sara Fratini. 2006. Tree-climbing behaviour of Cerithidea decollata, a western Indian Ocean mangrove gastropod (Mollusca: Potamididae). *J. Mar. Biol. Ass*., **86**:1429-1436.